Analysis of Occupational Safety and Health (K3) Risk Management in the Physics and Chemistry Laboratory of the Medan Occupational Safety and Health Center

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Analysis of Occupational Safety and Health (K3) Risk Management in the Physics and Chemistry Laboratory of the Medan Occupational Safety and Health Center

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Abstract.*The many possible risks associated with laboratory work are unavoidable. This study aimed to determine and analyze hazards, risks, impacts, risk levels and occupational safety and health (OHS) controls in the physics and chemistry laboratories of the Occupational Safety and Health Center (OHS) Medan. This is a qualitative research method with phenomenological approach hazard identification using Task Risk Analysis method using AS/NZS 4360: 2004 semi-quantitative. The tolerable risk threshold in the chemistry lab was 52, priority 3 was 10, and major was 11. The only thing OHS controlled in the physics lab was the air conditioning system. The presence of SOP (work procedures), MSDS (material safety data sheet) documents, OHS signs, supervision, managerial support, and the use of PPE masks, gloves, long-hand lab coats, rubber shoes, and other safety measures were all necessary in chemistry labs. Expanding the space, adding SOP, installing ventilation are all suggested at the physics laboratorium, Adopting ANSI / AIHA Z9.5-2003 ventilation guidelines, changing or replacing processes with safer chemicals, providing OHS training, and wearing coveralls and glasses are all recommended in the chemistry laboratory.*

Keywords: *OHS Risk Management, Task Risk Analysis, AS/NZS 4360:2004 Semi-Quantitative, Laboratory.*

1. INTRODUCTION

According to OSHA (Occupational Safety and Health Administration) the laboratory is a dangerous place to work. Laboratory workers are exposed to a variety of potential hazards including chemical, biological, physical and radioactive hazards, as well as musculoskeletal stress. LChemical laboratories are eleven times more dangerous than the industrial sector(1).The impact of pImproper handling of chemicals for example can also be detrimental to workers, resulting in accidents, serious injuries, health problems, loss of property and even death.(2)(3).Therefore, risk management analysis is a step taken to control risk, with the aim of preventing unwanted accidents in a comprehensive, planned and structured manner within an effective systematic framework.(4).

For this purpose, risk analysis needs to be carried out periodically in the laboratory to avoid unplanned or unexpected events that have a negative impact on the activities of individuals or organizations.This is also supported by the Regulation of the Minister of Manpower (Permenaker) of the Republic of Indonesia No. 5 of 2018 concerning Occupational Health and Safety (K3) in the Work Environment which requires all companies in Indonesia, both large and small, to prioritize aspects of worker protection by implementing K3 standards in the work environment in order to create a safe, healthy, and comfortable work environment and prevent work accidents and occupational diseases (PAK).(5).

Findings from previous studies indicate that laboratory accidents are quite common. As reported by Merdeka (2015) in Cahyaningrum (2020), on March 16, 2015, an accident occurred in the Chemistry Laboratory of the Faculty of Pharmacy, University of Indonesia, namely the explosion of a distillation flask during a practicum. On July 17, 2017, a similar incident occurred in the Laboratory of the Faculty of Teacher Training and Education, Syiah Kuala University, causing injuries to 2 people.(6). The explosion at the PT Obsidian Stainless Steel laboratory on August 14, 2019 resulted in 19 people being poisoned. The fire at the IPB laboratory on August 19, 2023 also killed a student.

Based on data from the Ministry of Manpower of the Republic of Indonesia, the results of processing work accident and work-related disease (PAK) data from the BPJS Employment Work Accident Insurance (JKK) program.in Indonesia as many as 210,789 cases in 2019, 221,740 cases in 2020, 234,370 cases in 2021, 265,334cases in 2022 and 159,127 cases in 2023. For the North Sumatra region, there were 9,472 cases of work accidents in 2023. More specifically, the type of work accident type A, namely being hit, scratched, cut, was 2,097 cases, type H, namely inhalation, absorption of hazardous materials or substances into the body through breathing or skin which resulted in poisoning, shortness of breath or other diseases, was 101 cases.This figure is an indication that the implementation of K3 must increasingly become a priority for the world of work in Indonesia.

According to global data released by the International Labor Organization (ILO), the number of KK and PAK cases in the world reaches 430 million per year consisting of 270 million (62.8%) KK cases and 160 million (37.2%) PAK cases, and causes the death of 2.78 million workers each year. As many as 40% of KK and PAK cases occur in young workers. The estimated economic loss is 3.94% - 4% of a country's Gross Domestic Product (GDP)(7). The Physics and Chemistry Laboratory of the Medan Occupational Safety and Health Center is an important aspect in carrying out its duties and functions in conducting work environment testing, handling company hygiene issues, occupational health and preventing work accidents in the company community.

The physics laboratory is a laboratory that contains test equipment ranging from large sizes such as the High Volume Air Sampler weighing around 50 kg to small test equipment such as flow meters, stopwatches, lux meters, impinger tubes, tool kits, and others. The activities carried out in the physics laboratory are preparing and checking equipment for the team that will take samples at the company, checking and returning the equipment after taking samples at the company. This activity takes place almost every day. Checking between equipment such as lux meters, sound level meters, vibration meters, and thermal environment

monitors twice a year, conducting equipment inventory twice a year, and maintaining equipment according to conditions.

Based on the initial survey, it was found that there had never been an in-depth analysis of risk management. From the results of the interview with the Head of the Medan K3 Center, the absence of risk management was because it had not been the focus of fulfilling the clauses in ISO 17025 and ISO 9001. This was also confirmed by the physics laboratory supervisor. In addition, one of the laboratory officers was of the opinion that the Medan K3 Center did not have a risk management analysis due to a lack of understanding of K3 risk analysis and the importance of it to be implemented and the absence of K3 audits in the center's laboratory.

Based on an interview with one of the laboratory officers, he complained that the room was hot because there was no AC or fan, there was a lot of dust so he had to always wear a mask when preparing the equipment and he had stumbled several times because the room was quite narrow. Ergonomic hazard factors were also seen when one of the officers was lifting heavy equipment. This was further reinforced by the condition of the room which was quite narrow with many partitions. Several potential hazards such as exposure to toxic and hazardous chemicals that can cause work-related diseases and even death, such as frequent scratches when opening aquades bottles. This is because the bottle caps that must be opened are made of tin or zinc which are quite sharp.

2. LITERATURE REVIEW

The importance of classifying or grouping hazardous chemicals into several types to facilitate recognition and handling. In general, hazardous chemicals can be divided into several categories, namely:

1. Toxic substances: Chemical substances that can cause harm to human health or even death if exposed through ingestion, inhalation, or skin contact.
2. Corrosive/irritant chemicals (Corrosive substances): Chemicals that can cause damage to body tissues such as skin, eyes, and respiratory tract, with the potential for injury, inflammation, irritation, and sensitization. Types of corrosive chemicals include liquids, solids, and gases.
3. Liquid corrosives: Potentially hazardous when in contact with skin or eyes, resulting in protein or denaturation. Examples include nitric acid, sulfuric acid, and hydrochloric acid.

4. Solid corrosives: The irritation caused by solid corrosives depends on the solubility of the substance in moist skin. Examples include sodium hydroxide, potassium hydroxide, and calcium hydroxide.
5. Corrosive gas: Very dangerous especially if inhaled and can damage the respiratory tract. Types of irritant gases can be grouped based on solubility, which also determines the target in the respiratory tract. Gases that are soluble in water, damage the upper respiratory tract, for example ammonia, hydrochloric acid, and formaldehyde.
6. Flammable chemicals: For example alkali metals such as Sodium, Potassium and Calcium.
7. Acid-reactive chemicals: React readily with acids, producing heat and flammable or corrosive gases.
8. High-pressure gas: Gas stored under pressure, can be compressed gas, liquefied gas, or dissolved gas. Examples include nitrogen, hydrogen, and acetylene.
9. Radioactive chemicals: Emit radiation rays such as alpha, beta, or gamma which can be harmful to the human body.(40)

3. METHODS

This research is a qualitative research, qualitative research is conducted with a phenomenological approach. Researchers choose to use this method with the consideration that the phenomenon being studied is a phenomenon that requires the use of deeper observation and observation and not using numerical or statistical models.The location of the research was carried out at the Physics and Chemistry Laboratory of the Medan Occupational Safety and Health Center located at Jl. KL Yos Sudarso Km11.5 No. 64, Medan Deli. This research was conducted from March - May 2024.

Informants as work partners are the first source of information that can provide various data needed related to field conditions. Informants are independent figures free from the influence of anyone including researchers and have no interests related to the research being conducted. Informants in this study are:

1. Key informants are those who know and have the basic information. The key informants in this study were the head of the center, the physics supervisor and the chemistry supervisor.
2. The main informants were those who were directly involved in laboratory activities, namely two (2) analysts (laboratory assistants) from the chemistry

laboratory and two (2) equipment administration officers from the physics laboratory.

4. RESULTS AND DISCUSSION

Results

Based on information from 3 informants, it is known that the K3 hazards in the physics laboratory are physical hazards from heavy equipment, the danger of poor lighting, and narrow spaces. The risks are falling equipment, being hit by equipment, and being hit.There is no documentation in the form of procedures owned by the physics laboratory. Therefore, in preparing sampling tools and intermediate checks based on experience gained from previous seniors. To prepare tools based on requests only. There is already a tool voucher from ISO 17025 2027. The sampling officer prepares a tool voucher to be given to the physics supervisor. After that, the physics supervisor hands it over to the tool officer to issue the tool according to request. Here are some photos while preparing the equipment and doing intermediate checks:

Figure 1. Activities in the Physics Laboratory

Based on the interview results above, it was found that the hazards and risks of K3 from the chemical laboratory were exposed to chemical solutions, inhaled chemical solutions, and exposed to glass fragments from falling flasks. The K3 risks caused by physical hazards were scratches from glass fragments, exposed to ovens, exposed to hot water, while the risks

of chemical hazards were exposed to spilled chemical solutions on the eyes or skin and inhaled chemicals.

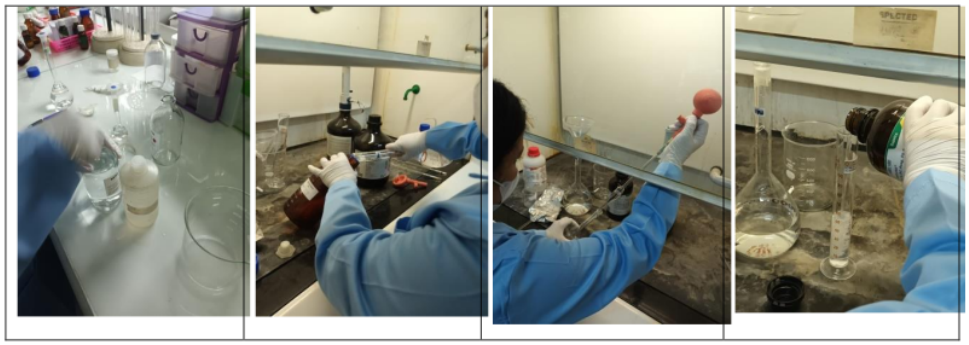

Figure 2. Activities in the Chemistry Laboratory

Discussion

Physics Laboratory Occupational Health and Safety Hazards and Risks

The technique of analyzing hazards and OHS risks in the physics laboratory in this study is the Task Risk Analysis method. This method determines the type of work to be analyzed, namely preparing sampling tools in and out of the laboratory and conducting checks between tools. Based on the results of interviews and observations in the field, the hazards and OHS risks in the physics laboratory include several categories of hazards, namely:

1. Physical Hazards
    a. Physical hazards from equipment in the laboratory. The risk of physical hazards is falling heavy and light equipment, being hit, pinched and scratched. Physics laboratory officers prepare sampling equipment in and out of the laboratory almost every day because there is a schedule of officers going to the field to take samples. The physical equipment prepared varies in size. There are large sizes weighing up to 20 kg to small sizes. Based on the results of observations, the narrow room conditions make it difficult for officers to move and the arrangement of laboratory equipment is also not well organized so that it can potentially cause accidents. This is in accordance with the research of Ika Bella (2022) that the arrangement of laboratory equipment that is not well organized can cause accidents in the laboratory.

b. Poor lighting

From the results of interviews and observations in the field, the physics laboratory has dim lighting. This hazard risk can cause eye fatigue. The laboratory has 6 lamps, 2 of which are broken (dead) and there are no lights in the partitioned room so it is quite dark. From the results of measurements using a Hagner brand lux meter type EC-1 at 9 measurement points in the physics laboratory, an average result of 119 lux was obtained. This does not meet the lighting standards according to the Regulation of the Ministry of Manpower No. 5 of 2018 concerning Occupational Safety and Health in the Work Environment and the Regulation of the Minister of Health of the Republic of Indonesia No. 48 of 2016 concerning Occupational Safety and Health in Offices where the lighting standard is 300 lux. Emergency lighting must be bright enough and available for a long enough period of time to ensure a safe exit from the laboratory (WHO, 2020).

c. No ventilation system

The room temperature in the physics laboratory is 21.8°C with a humidity of 61%. Although the temperature meets the standards for a comfortable office workspace, the ventilation system is not the same. The room is closed without any natural or artificial ventilation. The room has no windows or grilles. There is only one door as a source of air in and out. Poor air quality can cause the growth of mold and bacteria. In addition, it causes the risk of no exchange in the room and has an impact on health.

2. Ergonomic hazards

The condition of the room is narrow with so many tools of various sizes from small to large sizes that are not arranged properly. This makes it difficult to move when doing activities in the laboratory. In addition, falling or being hit when lifting heavy physical equipment. Ergonomic hazards can cause work fatigue.

Based on the office ergonomics standards of the Regulation of the Minister of Health of the Republic of Indonesia No. 48 of 2016 concerning Office Occupational Safety and Health "Each workspace must be made and arranged in such a way that each person working in the room gets at least 10 m3 of air space, preferably 15 m3. While when measuring in a physics laboratory with a room area of ±19.8m2, the results obtained were an air space of <7 m2.(48).

The Head of the Medan K3 Center made a policy of routine roll call every two weeks as a means of discussion and monitoring of all workers at the Medan K3 Center regarding the Center's internal activities including activities in the physics and chemistry laboratories. Each personnel can provide input, information, suggestions for laboratory improvement. In

addition, the policy taken in order to improve SOP through routine reviews once a year is adjusted to the needs of ISO 17025: 2017 and ISO 9001: 2015. It is not uncommon for the head of the Medan K3 Center to go down to the laboratory to see activities in accordance with procedures. In terms of support for the provision of PPE, management routinely supports its provision which is represented through each supervisor.

According to PP No. 50 of 2012, it is stated that management is responsible for increasing the effectiveness of occupational safety and health protection and for preventing and reducing work accidents, so that in this case if a work accident occurs, it is first seen how management regulates and controls the risk of danger. Heinrich's theory of accident causes can be grouped into two, namely: human factors as the main reason for accidents and management as the party responsible for preventing accidents. Management needs to prepare an appropriate and comprehensive work safety program to control potential hazards in laboratory. One of the programs that has not been routinely carried out by the Medan K3 Center is a health check specifically for workers in chemical laboratories.

Personal protective equipment

The Medan K3 Center Chemistry Laboratory implements mandatory PPE use for laboratory personnel. This is because some of the chemicals used such as HCl (hydrochloric acid) and H2SO4 (sulfuric acid) can cause serious health hazards if uncontrolled exposure occurs. HCl (hydrochloric acid) and H2SO4 (sulfuric acid) can produce vapors that are very corrosive and harmful to the respiratory tract. Based on the results of the interview, laboratory personnel did not use respirator masks because they were uncomfortable. This is in accordance with the recommendations of NIOSH (National Institute for Occupational Safety and Health) where this type of respirator uses a filter to remove particles from the inhaled air as shown in the picture below.

Figure 3. Types of Half Mask Respirator (58)

In addition, the use of protective clothing (coveralls) is also recommended to anticipate chemicals that are spilled and affect the entire body, especially the head area. According to research by Christian J. Kuster (2024)The results of the study showed that wearing work clothes protective clothing (coverall)offers substantial exposure reduction efficiently reduces chemical exposure and mitigates potential health risks to workers when used properly.(59)

5. CONCLUSION AND SUGGESTION

Conclusion

The following are the conclusions from the research results as follows:

1. K3 hazards in the physics laboratory are:physical hazards from heavy equipment, dim lighting, no air ventilation, and ergonomic hazards from narrow spaces. Meanwhile, the K3 risks of physics laboratories are falling heavy equipment, being hit by heavy equipment, being pinched, scratched, no air exchange because there is no ventilation, eye fatigue and limited movement because of narrow spaces.
2. K3 Impact in the physics laboratory is injury or injury from falling equipment, eye fatigue due to dim lighting, work fatigue due to narrow spaces, and the emergence of diseases from poor ventilation.
3. K3 hazards in chemical laboratories are physical hazards such as from falling glass fragments, hot water, and the use of ovens and chemical hazards, namely chemicals. K3 risks caused by physical hazards include being scratched by broken glass, being hit by an oven, being hit by hot water, while chemical hazards include being exposed to spilled chemical solutions on the eyes or skin and being inhaled by chemicals
4. The impact of K3 in the chemistry laboratory isis causing minor injuries when exposed to glass scratches, causes minor irritation, serious irritation to blindness when in contact with eyes, causes minor irritation, serious irritation, allergies, skin burns when in contact with skin, and causes dizziness, nausea, cough, choking, damage to upper respiratory tract tissue,sensitivity to the lungs. If inhaled continuously it can cause organ damage, genetic damage, cancer and chronic inflammation.

5. Risk levels in physics laboratories acceptable risk level is 6, priority 3 is 2.
6. Risk levels in chemical laboratories acceptable risk level of 52, priority 3 of 10, and substantial of 11.
7. Control in the physics laboratory of the Medan K3 Center only includes work climate control, namely by using AC.
8. Control in the chemical laboratory of the Medan K3 Center already has AC, ventilation system using AC and exhaust fan, placement of chemicals according to the type of material, application of Material Safety Data Sheet (MSDS), Standard Operating Procedure (SOP), K3 signs, supervision, management support, application of Personal Protective Equipment such as masks, gloves and long-sleeved lab coats and rubber shoes.

Suggestion

Medan Occupational Safety and Health Center

In the physics laboratory the following is recommended:

1. Acceptable risk level indicates that the intensity of activities that cause risk is reduced to a minimum, namely in the preparation of equipment and intermediate checks. While the priority 3 risk level indicates that the activity requires attention and supervision from the physics supervisor.
2. Replacing and adding light bulbs to eliminate the risk of dim lighting hazards.Replace light bulbs with types that have a longer service life and more efficient energy consumption.
3. Ventilation installation to circulate clean air or remove contaminated air from the laboratory.
4. Making Standard Operating Procedure (SOP) as an administrative control effort for risk danger of being hit by tools and the danger of awkward postures while working.
5. Carrying out room expansion to overcome danger factors of being hit by tools, falling tools and ergonomic danger factors of working with awkward postures.

In the chemistry laboratory the following is recommended::

1. On 52 activities Acceptable risk level indicates that the intensity of activities that cause risk is reduced to a minimum.
2. At priority risk level 3, there are 10 activities which indicate that these activities require attention and supervision from chemical supervisors.

3. Ona substantial risk level indicates that the activity requires immediate corrective action referring to the existing control hierarchy, namely elimination, substitution, engineering, administrative control, and use of PPE.
4. Adding ventilation to chemical laboratories in accordance with the American National Standard for Laboratory Ventilation ANSI/AIHA Z9.5-2003 to optimize air exchange in the laboratory as an effort to overcome the risk of inhaling chemicals that have a negative impact on health.
5. In chemical laboratories, it is recommended to use coverall work clothes and goggles to completely protect the worker's body from the possible risk of chemical spills.
6. Replacing procedures with safer chemicals in accordance with increasingly sophisticated technological developments or referring to standards of other countries that are traceable through the International System.
7. Supervise the use of filtered masks to ensure consistent use during laboratory activities.
8. Conduct periodic health checks once a year for workers, especially those working in laboratories.
9. It is necessary to conduct training on risk management analysis for physics and chemistry laboratory staff. This is an effort ensure officers understand and can implement correct safety procedures to reduce work accidents and work-related diseases and preparing officers to respond to emergency situations quickly and effectively.

Providing training for chemical laboratory personnel on the effectiveness of PPE use in order to reduce the severity of accidents and prevent repeated exposure to chemicals so that it can consistently create a safety culture and increase risk awareness among personnel.

REFERENCES

Abraham, A. (2020). *Safety management system*. The Rawman & Littlefield Publishing Group, Inc.

Ariani, A. R. (2016). Hazard identification and risk assessment (HIRA) as an effort to reduce the risk of workplace accidents and the risk of work-related diseases in the production division of PT. Iskandar Indah Printing Textile Surakarta. Muhammadiyah University of Surakarta.

Australian/New Zealand Standard. (2004). *OHS risk management handbook*. Standards Australia International Ltd.

Daryaningrum, H., Pujotomo, D., & Puspitasari, N. (2015). Occupational safety and health (K3) risk management for workers in the wood processing production division using the JSA method. *PT Kharisma Jaya Gemilang Ind Eng Online J, 4*(2).

David, A. C. (1990). *Industrial safety: Management and technology*. Prentice Hall Inc.

Employment, K. (2018). *K3 work environment*. Indonesia.

Fathmi, R. (2022). Hazard risk analysis using the HIRADC method at the multifunction laboratory of Ar-Raniry State Islamic University Banda Aceh. *Jurnal, 114*.

Government, P. (2012). Implementation of SMK3.

Hadipranoto, I., Winkandari, R. J., Widiyanto, S. D., & Kahar, F. (2022). Analysis of risk levels in the laboratory of the Health Analyst Department of the Ministry of Health Polytechnic of Semarang in 2021. *J Sulolipu Media Komun Civitas Akademik dan Society, 22*(1), 120–134.

Hakim, T. L., Suriyani, M. Y., Paramita, A., & Harliyanti, W. (2023). Hazard identification and risk assessment to control potential work accidents in the basic climate laboratory of the Kalimantan Institute of Technology (ITK). *Scientific Physics Education Journal (SPEJ), 7*(1), 8–19.

Health, K. (2016). *Occupational safety and health*. Indonesia.

Hutahuruk, V. V., J, N., Amin, M., Raviola, R., & Edigan, F. (2022). Analysis of risk management in special COVID-19 laboratory officers at Mandau Duri Regional General Hospital in 2021. *Media Kesmas (Public Health Media), 2*(1), 347–362.

Indasah, D. I., & Antoninda, D. D. (2024). *Risk management in the workplace*. CV Budi Utama.

Indonesia National Occupational Safety and Health Profile 2022. (2022). Ministry of Manpower. Retrieved from https://satudata.kemnaker.go.id/satudatapublic/2022/10/files/publikasi/1675652225177_Profil%2520K3%2520Nasional%25202022.pdf

Kolluru. (1996). *Risk assessment and management handbook: For environmental, health, and safety professionals*. McGraw Hill, Inc.

Kurniawati, A. T., Alayyannur, P. A., Haqi, D. N., Martiana, T., Arini, S. Y., & Alfin, W. F. (2020). Risk management by implementing hazard identification, risk assessment and determinant control (Hiradc) method in the research center of the university in Surabaya, Indonesia. *Indian Journal of Forensic Medicine & Toxicology, 14*(1), 195–200.

Law, U. (1970). *Work safety*. Indonesia.

Maasily, N., Jamlaay, O., Maelissa, N., Sipil, J. T., & Ambon, P. N. (2023). Risk analysis on the integrated laboratory building construction project supporting the Masela Block, Pattimura University. *J Agreg, 2*(1).

Manlian, R. A., & Simanjuntak, R. P. (2012). Identification of causes of work accident risk in building construction activities in DKI Jakarta. *J Ilm Media Engineering, 2*(2), 96893.

Meiditama, M. F., & Sundana, S. (2023). Risk analysis in refrigerator production process using FMEA method at PT. Panasonic Manufacturing Indonesia. *J Baut dan Manufaktur, 5*(1), 7–17.

Meily, L. K. (2010). *Theory and application of occupational health*. Publisher of University of Indonesia (UI-Press).

Nasrallah, I. M., El Kak, A. K., Ismail, L. A., Nasr, R. R., & Bawab, W. T. (2022). Prevalence of accident occurrence among scientific laboratory workers of the public university in Lebanon and the impact of safety measures. *Safety and Health at Work, 13*(2), 155–156.

National Research Council. (2010). *Laboratory safety and security: A guide to prudent chemical management*. National Academy Press.

Nurhasanah, F., Rinawati, S., & Sari, Y. (2022). The relationship between discipline in using personal protective equipment and knowledge of K3 with occupational accidents in workers in the materials section of PT Prima Wana Kreasi Wood Industry. *Jurnal Kesehatan Masyarakat, 10*(5), 579–586.

Of, I. L. (n.d.). A 5 step guide.

OSHA. (2024). *No title*. Americans.

Puspitasari, N. (2010). Hazard identification and risk assessment in an effort to reduce the level of risk in the production sector. Semarang: PT. Bina Guna Kimia Ungaran.

Ramli Soehatman. *Smart safety: SMK3 based on behavior*. Prosafe Institute Safety Development Foundation.

Ridasta, B. A. (2020). Assessment of occupational safety and health management system in chemical laboratory. *HIGEIA: J Public Health Research and Development, 4*(1), 64–75.

Rofiani, D., Arbi, Y., & Lisha, S. Y. (2023). Analysis of K3 risk potential using the HIRARC method (Hazard Identification, Risk Assessment and Risk Control) in the microbiology laboratory, Faculty of Medicine, UNAND. *Jukung (Environmental Technology Journal), 9*(2), 69–82.

SMKN Land, Using, L., & Hira, M. (2023). *Jurnal, 23*(2), 97–105.

Sobah, F., & Maulitana, I. M. (2019). Study of hazard identification and risk assessment using the TRA (Task Risk Assessment) method as an effort to prevent work accidents in car air conditioner repair work at the Hyundai Wiyung workshop, Surabaya. *Jurnal Pendidikan Teknik Mesin, 9*(1), 37–46.

Sucipto. (2014). *Occupational safety and health*. Gosyen Publishing.

Sulistiyowati, R., & Herdiman, L. (2023). Analysis of occupational safety and health in practical activities using the HIRA method. *Indonesian Journal of Laboratory, 1*(1), 52.

Suma'mur. (2009). *Company hygiene and occupational health (Hiperkes)*. Sagung Seto.

Supriyadi, S., & Ramdan, F. (2017). Hazard identification and risk assessment in boiler division using hazard identification risk assessment and risk control (Hirarc). *Journal of Engineering Hygiene and Occupational Health, 1*(2), 161.

Syakbania, D., & Wahyuningsih, A. (2017). Occupational safety and health program in chemical laboratory. *HIGEIA: J Public Health Research and Development, 1*(3), 49–57.

Tarwaka. (2008). *Occupational health and safety management and implementation of K3 in the workplace*. Harapan Press.

Widiastiti, I. I. G. A. A. M. (2023). Hazard control analysis using the hazard identification risk assessment and risk control (HIRARC) method in the occupational safety and health (K3) program in the food microbiology laboratory, Faculty of Agricultural Technology, Uda University. *Jurnal, (November)*, 274–278.

WR, et al. (2023). *Occupational health and safety anthology*. PT Media Pustaka Indo.

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